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A Radiometric View of Io's Volcanology and Geophysics

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Infrared radiometry of Io as a function of longitude and time at 4.8, 8.7 and 20pm characterizes the temperatures, the spatial distribution, and the temporal evolution of thermal anomalies. We present data collected with the NASA IRTF from 1983 to 1993. Roughly equal amounts of power are emitted from both the leading and trailing hemisphere in spite of the location on the trailing hemisphere of Loki (the single largest volcanic center on Io). Although thermal emission at 4.8 μm is highly variable, the total power output has been stable over the last decade. The average heat flow is 2.5 (s.d. =0.29) W/m^2 or 1.05^{14} (s.d. =0.12) W with the maximum observed change between. apparitions 20%. This is significantly higher than permitted for steady state by current models of the Jupiter-Io tidal interaction and Io's orbital evolution. The increase in. heat flow over our previous estimates is due to the development of an improved background model for the surface of Io. This model allows for the recognition of lower " temperature, cooler thermal anomalies than had been. detected earlier. We have observed two outbursts. The first in 1986, suggested a temperature of - 900 K. The second on. January 9, 1990 is best modeled by a source at the location of Loki with a temperature of 1200 K and radius of 5.6 km at the beginning of the observations and a temperature of 700 K and radius of 13 km 3 hours later. These temperatures are too high to be explained by molten sulfur, but are quite reasonable for silicate eruptions and imply a high rate of resurfacing by lava flows.

This work was done at JPL/ CALTECH, under contract to NASA.
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